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Blankenship

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(54) **METHOD FOR TUNING A GOLF CLUB HEAD WITH A VARIABLY DAMPENED FACE**

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(51) **Int. Cl.**
A63B 53/04 (2006.01)

(52) **U.S. Cl.** **473/326**; 473/329; 473/332; 473/333; 473/409

(58) **Field of Classification Search** 473/324–350, 473/244–247, 409
See application file for complete search history.

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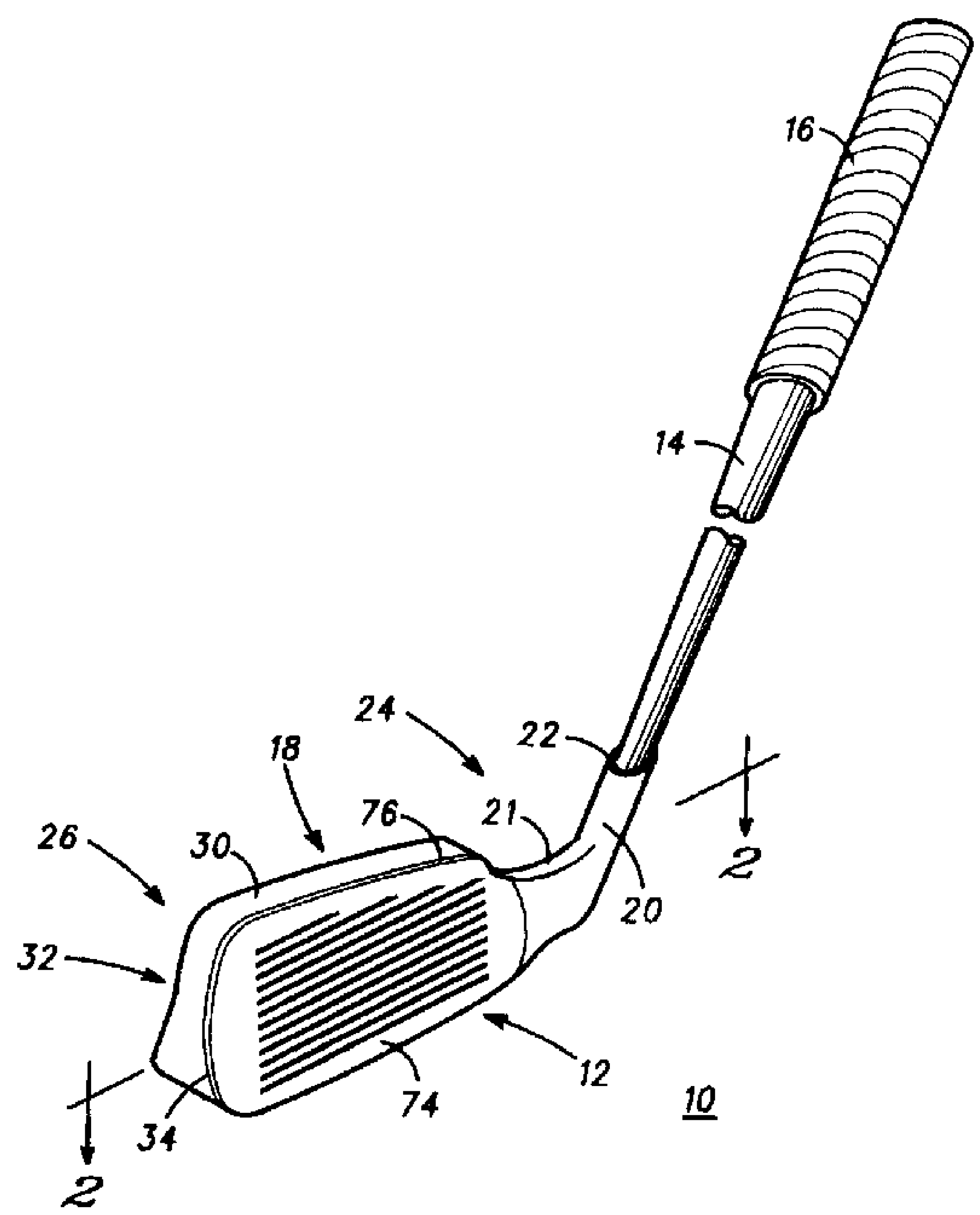
(57) **ABSTRACT**

A method for tuning a golf club head where the golf club head includes a body having a front surface, a back surface, a heel end, a toe end, a sole extending between lower portions of the heel and the toe ends, and a top rail extending between upper portions of the heel and toe ends. A face is coupled to the body through a rheological fluid. The golf club head is tuned by changing the viscosity of the rheological fluid.

5 Claims, 3 Drawing Sheets



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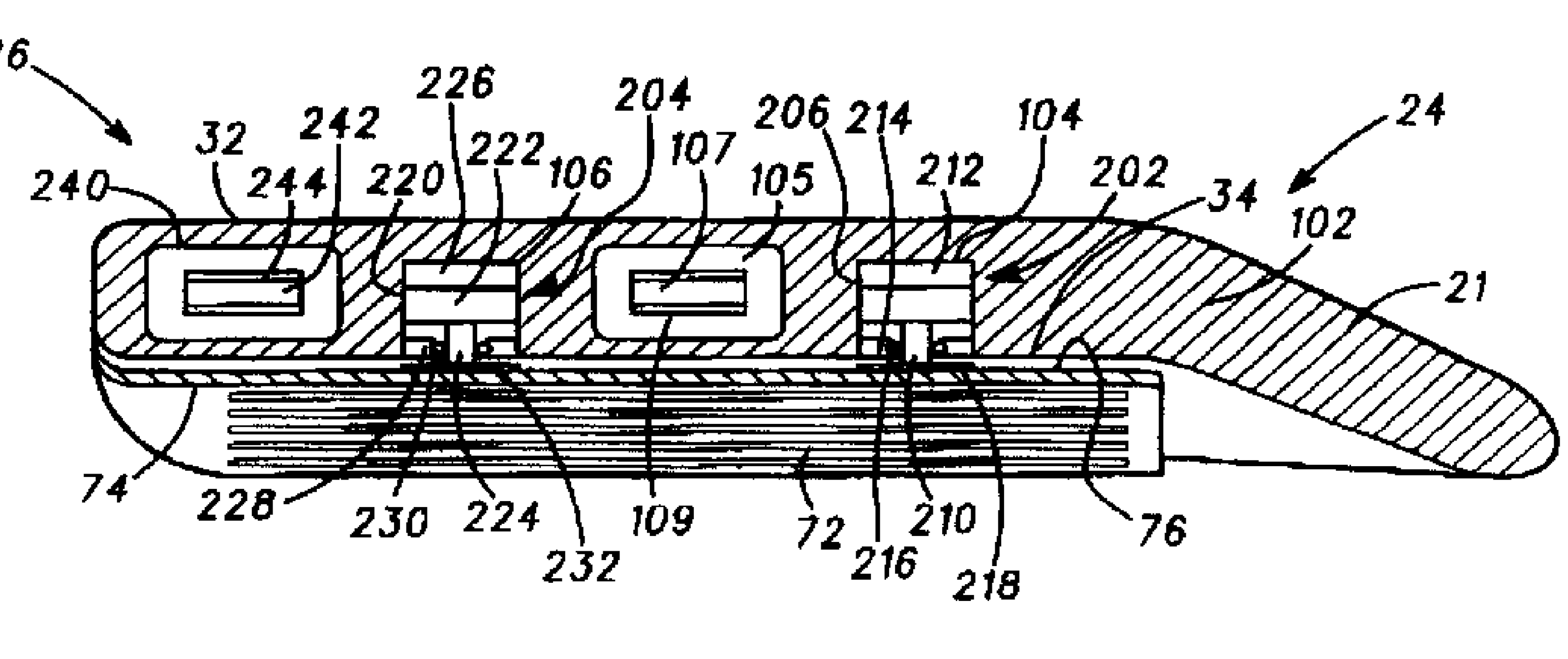

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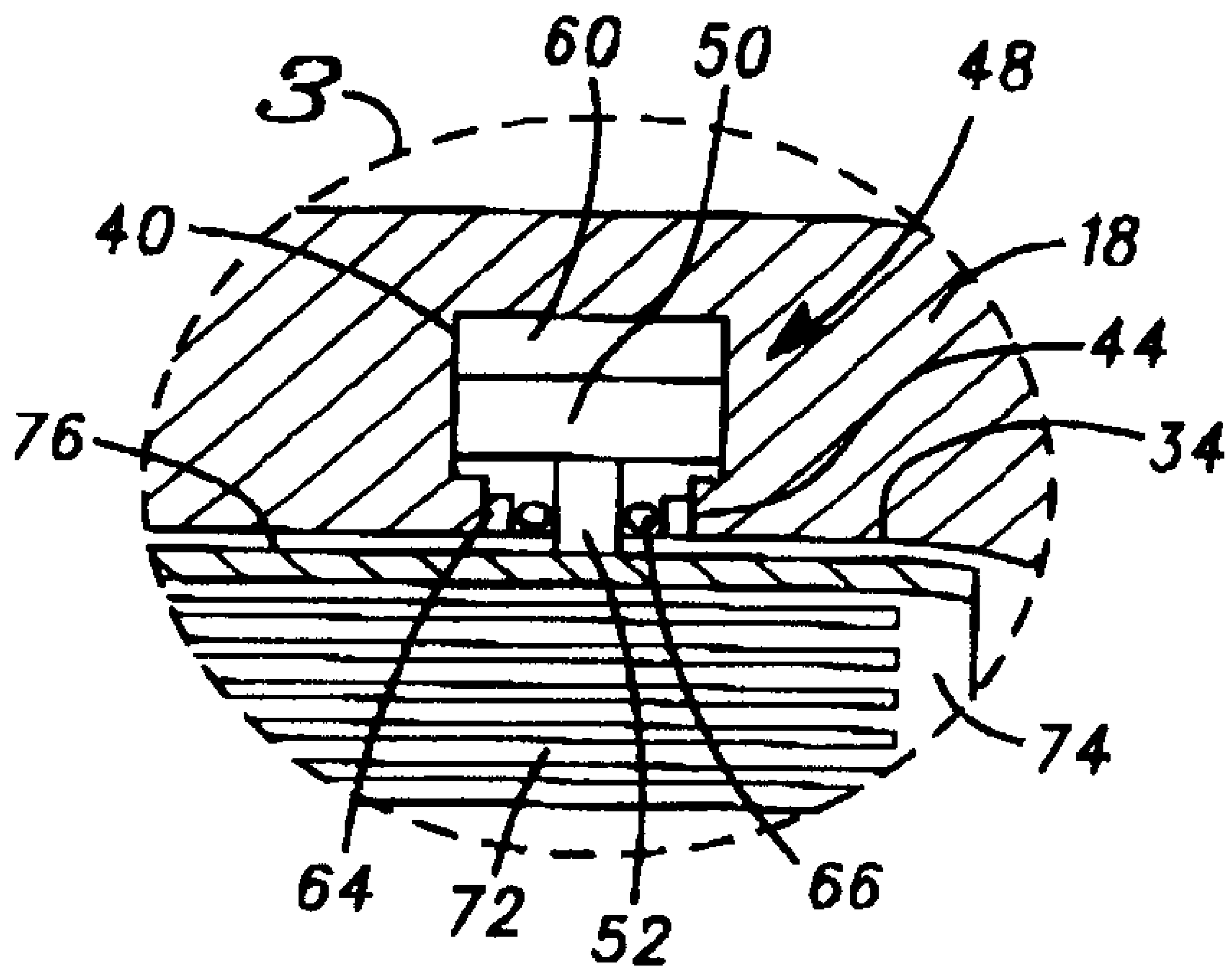

Fig. 3

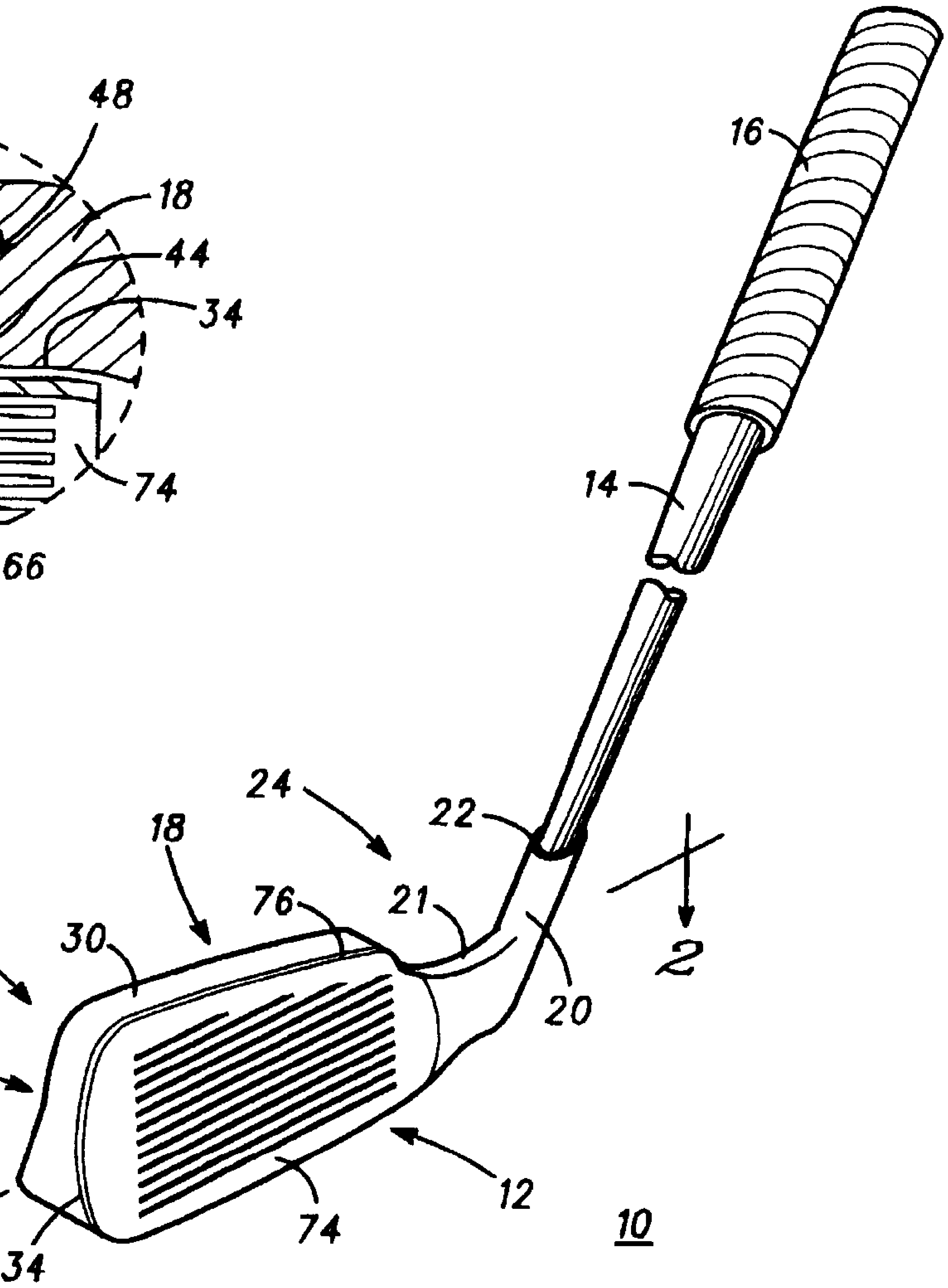

Fig. 1

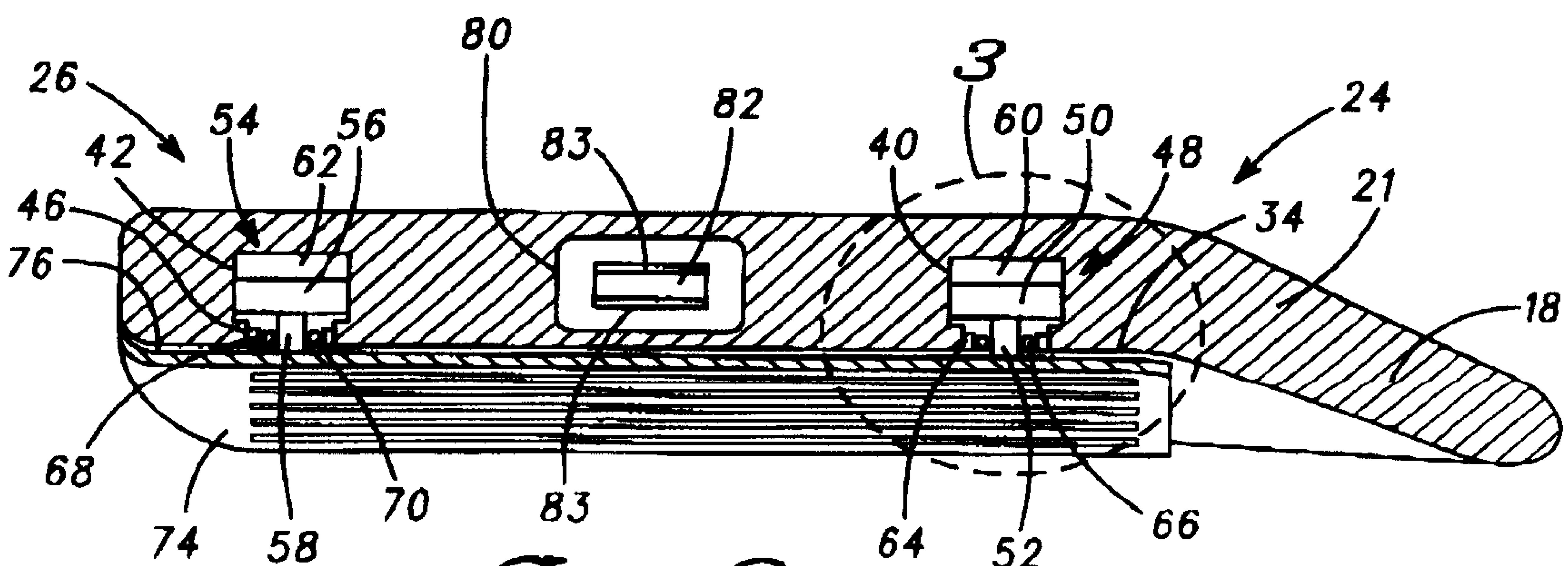

Fig. 2

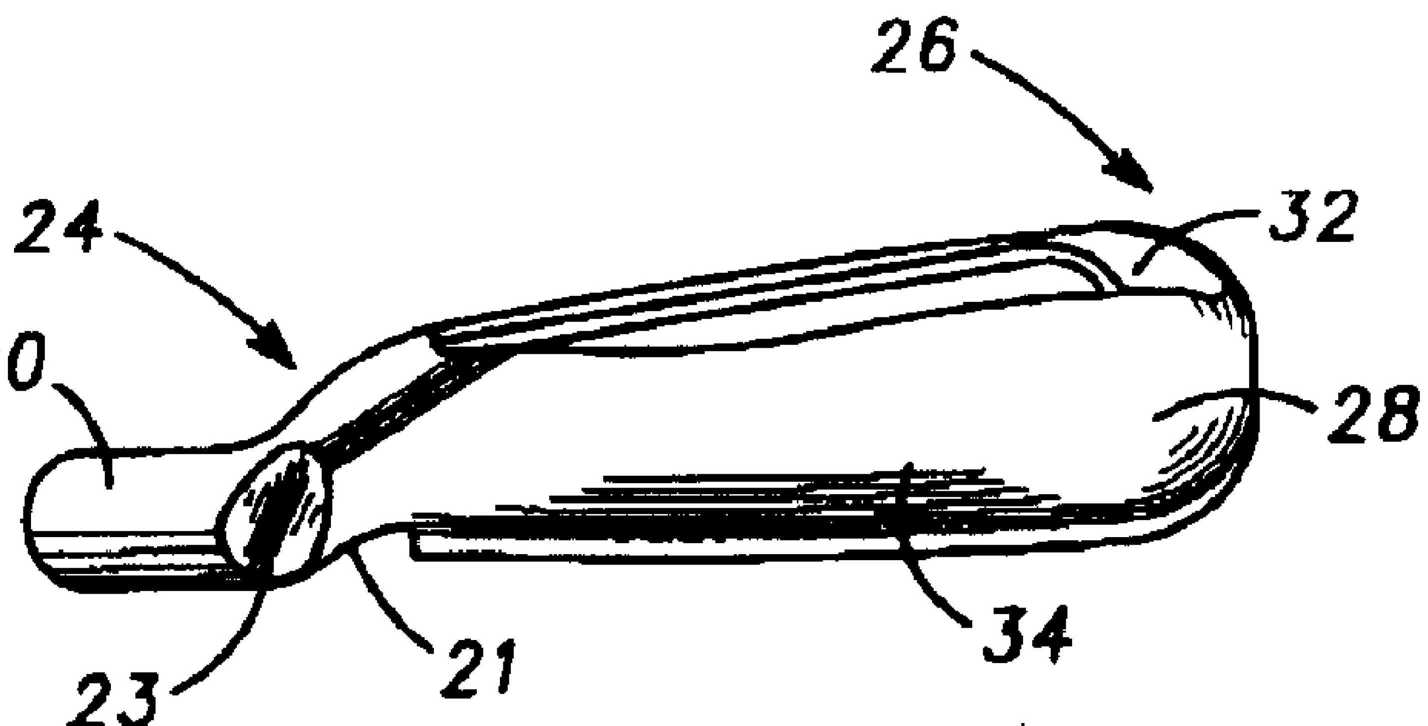

Fig. 4

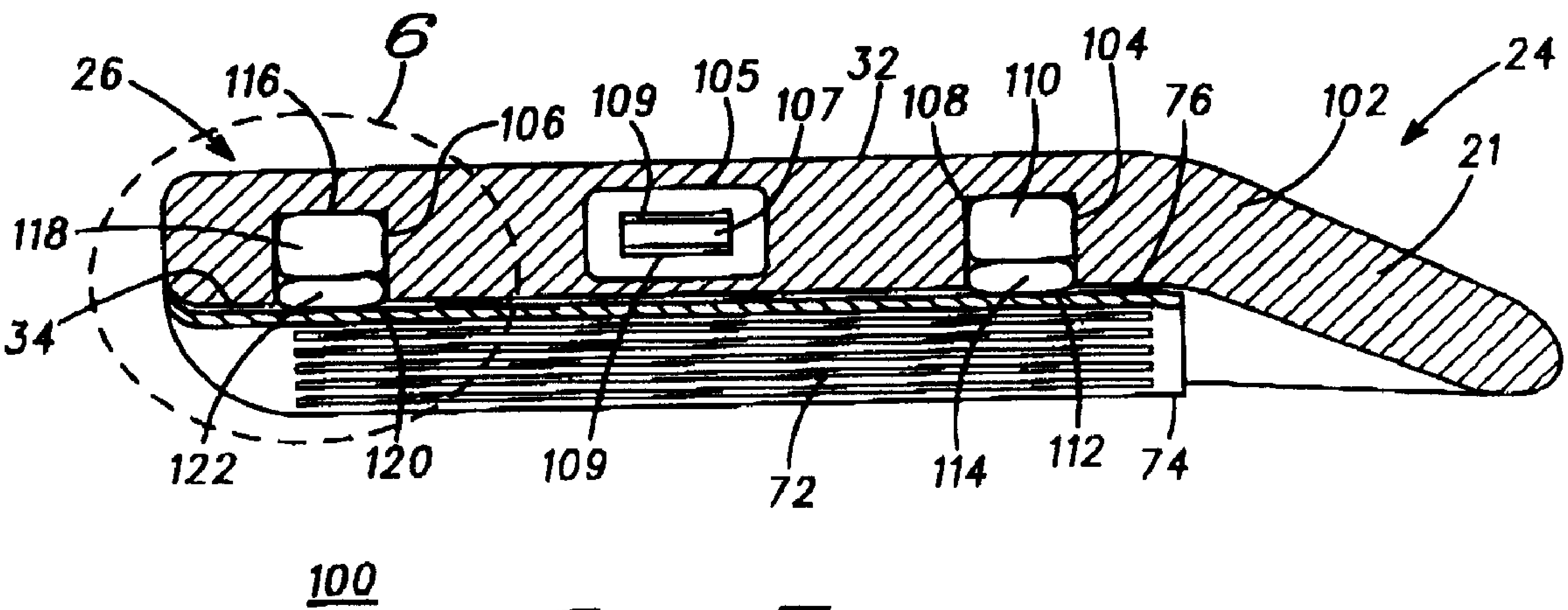

Fig. 5

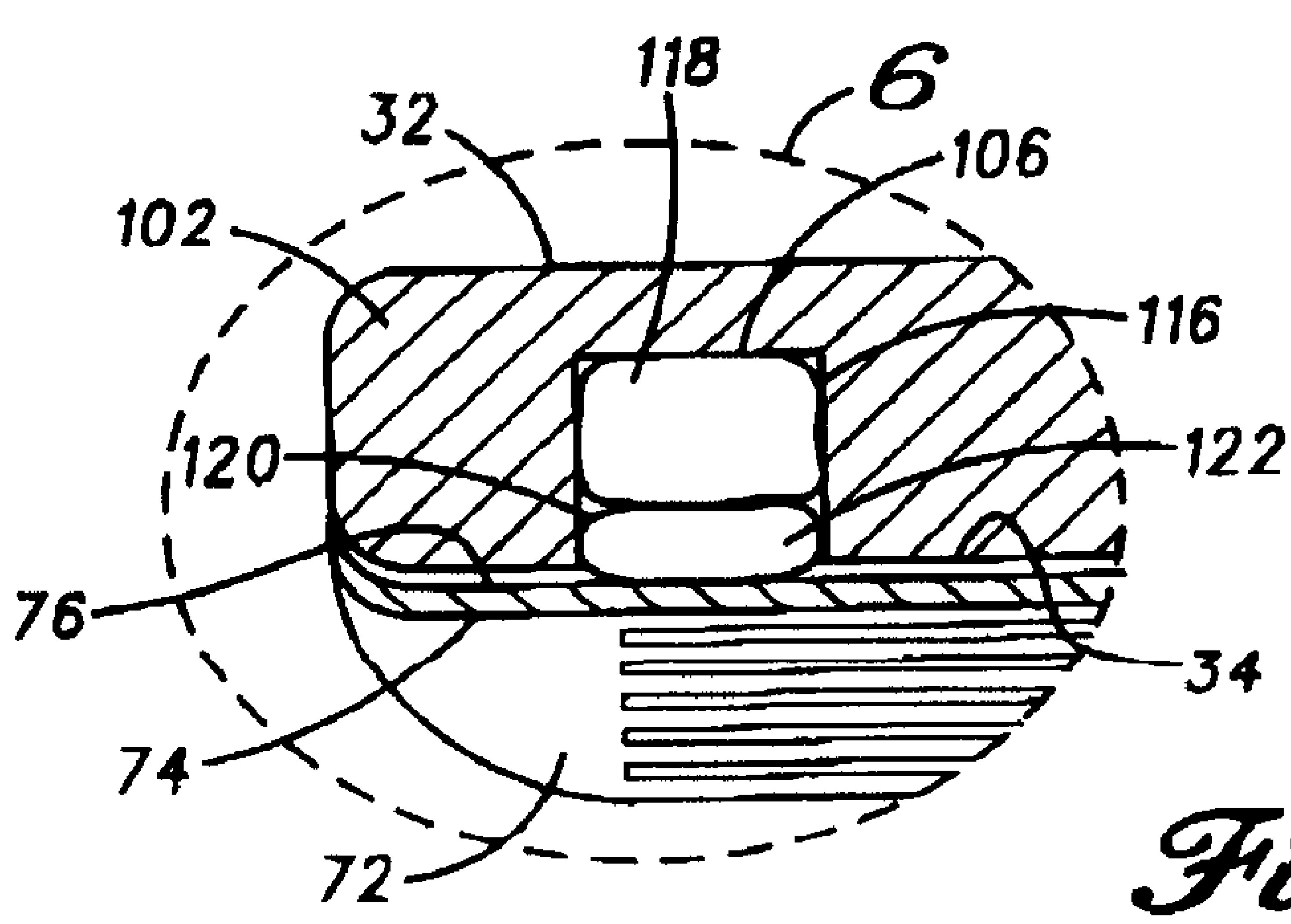

Fig. 6

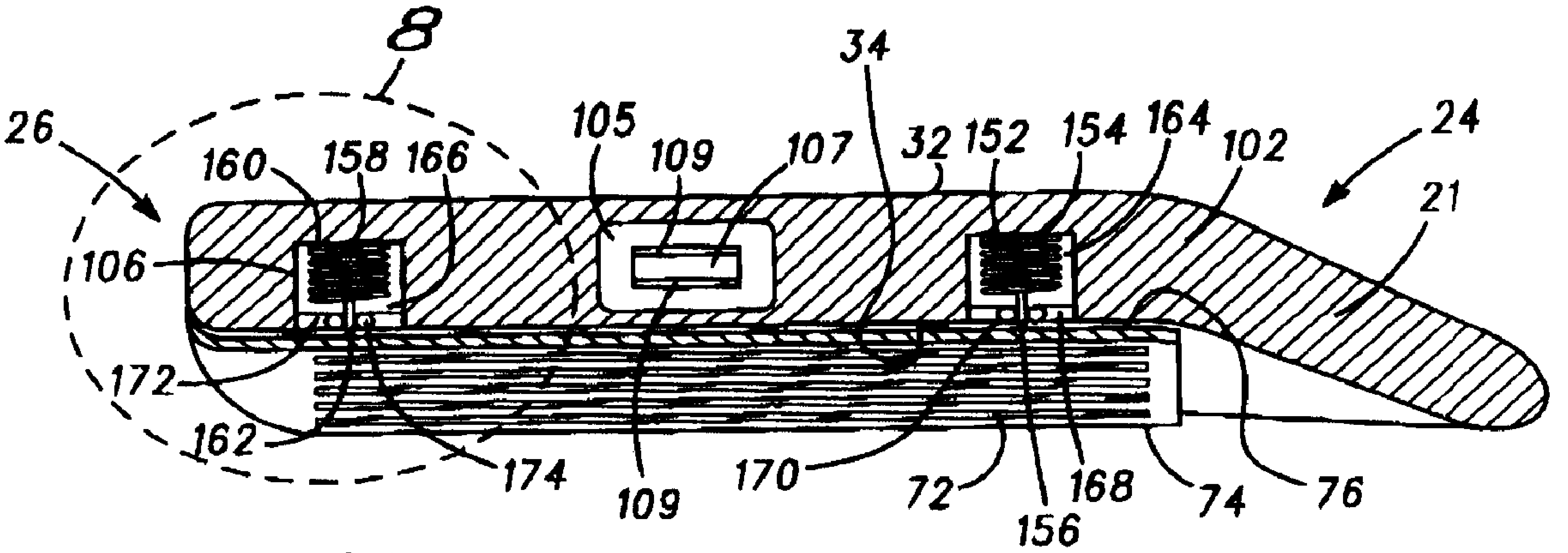

Fig. 7

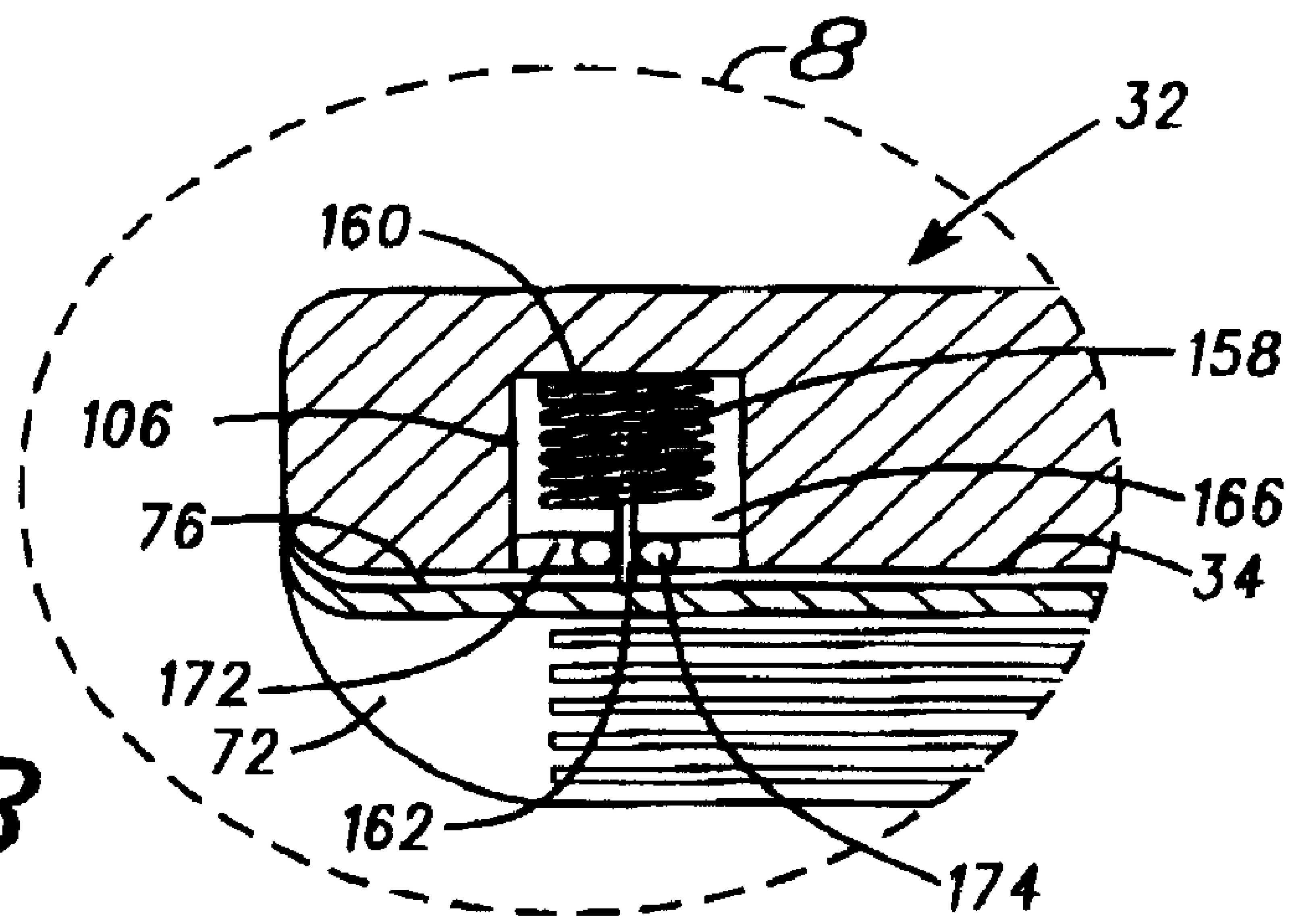

Fig. 8

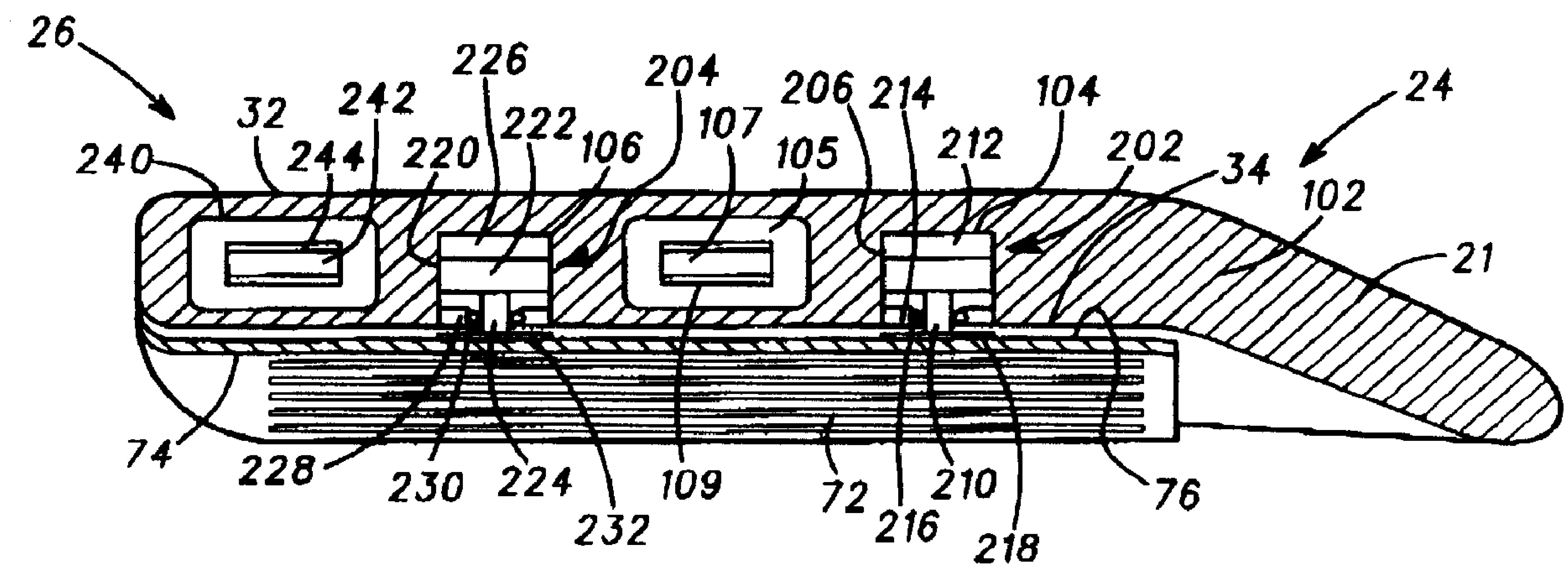

Fig. 9

METHOD FOR TUNING A GOLF CLUB HEAD WITH A VARIABLY DAMPENED FACE

BACKGROUND OF THE INVENTION

This is a division of application Ser. No. 10/969,453 filed Oct. 19, 2004 now U.S. Pat. No. 7,192,363.

The present invention relates, in general, to golf equipment and, more particularly, to a golf club head with a variably dampened face.

An important factor governing the distance and accuracy of a golfer's drive is the amount of energy transferred from the golf club head to a golf ball when it impacts the golf ball. Ideally, the point of impact on the face of the golf club head is below the center of gravity of the golf club head and the point of impact on the golf ball is below the center of gravity of the golf ball. In addition, the theoretical plane containing the impact point on the golf club head, the center of gravity of the golf club head, and the center of gravity of the golf ball should be in alignment with the intended travel path of the golf ball. When these conditions are met, the golf club head is properly aligned and produces maximum face response characteristics.

To help golfers achieve proper alignment, golf club manufacturers have concentrated a relatively large mass of the golf club head in its sole. This configuration has made it easier for a golfer to place the center of gravity of the golf club head below the center of gravity of the golf ball; however it is still difficult for a golfer to achieve perfect alignment. For example, a golfer may have the club head square immediately prior to impact, but the actual point of impact with the club head may be shifted from the desired point on the club head to either the heel end or the toe end. This results in improper alignment because the club head becomes twisted to an out of square position and results in less than the maximum amount of energy being transferred to the golf ball. The terms twisting, twisted, or gyration are used here to define a rotation of the club head at the time of impact about an axis which passes through the center of gravity of the club head and is parallel to the axis of the golf club shaft. To dampen or reduce the effects caused by twisting of the club head, golf club manufacturers have placed relatively large concentrations of mass in the heel and toe of the club head to increase the moment of inertia and thereby maximize the energy transfer from the club head to the golf ball. Although these techniques have improved the ability of the golfer to increase the consistency with which they properly align the golf club, slight misalignment of the golf club head results in less than optimum face response characteristics.

Accordingly, what is needed is a golf club head, a method of manufacturing the golf club head, and a method for tuning the golf club head that permits adjusting the face response characteristics of the golf club head.

SUMMARY OF THE INVENTION

The present invention provides a method for tuning a golf club head using a variable viscosity fluid.

The method for tuning a golf club head comprises providing a golf club head having a body which has a front surface, a back surface, a heel end, a toe end, a sole extending between lower portions of the heel and toe ends, and a top rail extending between upper portions of the heel and toe ends. A shock absorber structure is coupled to the body, and a face plate is coupled to the shock absorber structure.

DESCRIPTION OF THE DRAWINGS

The present invention will be better understood from a reading of the following detailed description, taken in conjunction with the accompanying drawing figures, in which like reference numbers designate like elements and in which:

FIG. **1** illustrates golf club including an iron-type golf club head in accordance with an embodiment of the present invention;

FIG. **2** illustrates a cross-sectional top view of the iron-type golf club head of FIG.

FIG. **3** is an expanded view of the portion of the iron-type golf club head enclosed within the circle indicated by broken line **3** shown in FIG. **2**;

FIG. **4** illustrates a bottom view of the iron-type golf club head of FIGS. **1** and **2**;

FIG. **5** illustrates a cross-sectional top view of an iron-type golf club head in accordance with another embodiment of the present invention;

FIG. **6** is an expanded view of the portion of the iron-type golf club head enclosed within the circle indicated by broken line **6** shown in FIG. **5**;

FIG. **7** illustrates a cross-sectional top view of an iron-type golf club head in accordance with yet another embodiment of the present invention;

FIG. **8** is an expanded view of a portion of the iron-type golf club head enclosed within the circle indicated by broken line **8** shown in FIG. **7**; and

FIG. **9** illustrates a cross-sectional top view of an iron-type golf club head in accordance with yet another embodiment of the present invention.

DESCRIPTION OF THE INVENTION

Generally, the present invention provides a method and structure for adjusting the face response characteristics of a golf club head. As those skilled in the art are aware, the portion of the golf club head that makes contact with the golf ball is commonly referred to as the face. A golf club head in accordance with the present invention comprises a face that is separate and spaced apart from the body of the golf club head. The body has dampening structures comprising a rheological fluid that can be tuned using a magnetic or electric flux. When the rheological fluid interacts with a magnetic field from a magnet, the rheological fluid becomes either more viscous or less viscous. The desired viscosity is selected in accordance with a golfer's desired face response characteristics. Once selected, the source of the magnetic field is fixed in place, thereby setting the viscosity. Thus, the face is tunably coupled to the body.

FIGS. **1**, **2**, **3**, and **4** depict various views of a golf club in accordance with an embodiment of the present invention. For the sake of clarity, FIGS. **1-4** are described contemporaneously with each other rather than sequentially. Briefly, FIG. **1** illustrates a golf club **10** including an iron-type golf club head **12** and golf club shaft **14**; FIG. **2** illustrates a cross-sectional top view of iron-type golf club head **12**; FIG. **3** illustrates an expanded view of the portion of iron-type golf club head **12** encircled by broken line **3** in FIG. **2**; and FIG. **4** illustrates a bottom view of iron-type golf club head **12**. Iron-type golf club head **12** is coupled to one end of the golf club shaft **14** and a grip **16** is coupled to an opposing end of golf club shaft **14**. Suitable materials for golf club shaft **14** include steel and graphite. Although golf club head **12** is shown as an iron-type golf club head, it could also be a putter or a wood-type club head.

Iron-type golf club head **12** includes a body **18** and a hosel **20**, which has a cylindrical bore **22** for receiving one end of golf club shaft **14** (shown in FIG. **1**). Body **18** has a heel end **24** spaced apart from a toe end **26**. A sole **28** (shown in FIG. **4**) extends from a lower portion of heel end **24** to a lower portion of toe end **26** and a top rail **30** (shown in FIG. **1**) extends from an upper portion of heel end **24** to an upper portion of toe end **26**. Body **18** has a back surface **32** that extends between heel end **24** and toe end **26** along a back or rear portion of body **18**. Body **18** further includes a front surface **34** that extends between heel end **24** and toe end **26**. Hosel **20** includes a neck **21** connected to heel end **24** of body **18**. Neck **21** has a notch **23** (shown in FIG. **4**) in the lower surface of neck **21**. Club head **12** may be formed by casting, machining from solid castings, or the like. Suitable materials for club head **12** include, but are not limited to, stainless steel, titanium, aluminum, nickel, alloys of titanium, alloys of aluminum, alloys of nickel, and the like.

T-shaped piston cavities **40** and **42** having openings **44** and **46** and sidewalls, respectively, extend from front surface **34** into body **18**. Piston cavities **40** and **42** can be formed by techniques such as, for example, molding, machining, and the like. A piston assembly **48** comprising a piston **50** coupled to a piston rod **52** is positioned in piston cavity **40** and a piston assembly **54** comprising a piston **56** coupled to a piston rod **58** is positioned in piston cavity **42**. Piston rods **52** and **58** may include protrusions (not shown) extending perpendicularly from rods **52** and **58** which impinge on the flow of fluid in cavities **40** and **42**, respectively. Magneto-rheological fluid (MRF) **60** is placed in piston cavity **40** and magneto-rheological fluid (MRF) **62** is placed in piston cavity **42**. Optionally, piston assemblies **48** and **54** include openings (not shown) to facilitate the flow of magneto-rheological fluid **60** and **62** in cavities **40** and **42**, respectively. Typically magneto-rheological fluids are composed of three components: a carrier fluid, magnetic particles, and additives. The carrier fluid acts as the medium for the other components. Suitable media for the carrier fluid include, for example, silicone oil, hydrocarbon fluid, and mineral oils. The particles are ferrous in nature and therefore become polarized in the presence of a magnetic field. The polarization changes the viscosity of the magneto-rheological fluid. The additives are used to provide stability to the mixture, corrosion control, and lubrication and include anti-oxidants, pH shifters, dyes and pigments, salts, and deacidifiers. Suitable magneto-rheological fluids are known to those skilled in the art. Alternatively, a magneto-rheological gel or an electro-rheological fluid can be used in place of the magneto-rheological fluid.

Opening **44** is sealed with an end cap **64** and O-ring assembly **66** and opening **46** is sealed with an end cap **68** and O-ring assembly **70**. The mechanism for sealing openings **44** and **46** is not a limitation of the present invention. Other sealing mechanisms that prevent leakage of magneto-rheological fluid from piston cavities **40** and **42**, prevent air from entering piston cavities **40** and **42**, and align piston rods **52** and **58** may be used.

A golf club face plate **72** having a front surface **74** and a back surface **76** is attached to piston rods **52** and **58**. Front surface **74** forms a face of golf club head **12** and is designed for impacting a golf ball. Techniques for attaching piston rods **52** and **58** include welding or brazing. Alternatively, an adhesive may be applied to the ends of piston rods **52** and **58**, or to the portions of back surface **76** that mate with piston rods **52** and **58**, or to the ends of piston rods **52** and **58** and to back surface **76**. After applying the adhesive, piston rods **52** and **58** are bonded to back surface **76**. In another alternative, piston rods **52** and **58** may be attached to golf club face plate **72** using one or more set screws. In yet another alternative, piston rods **52** and **58** may be attached to golf club face plate **72** by threading the ends of piston rods **52** and **58**, forming threaded grooves in golf club face plate **72**, and screwing rods **52** and **58** into the threaded grooves. It should be understood the technique for attaching piston rods **52** and **58** to golf club face plate **72** is not a limitation of the present invention.

A cavity **80** is formed in body **18** and a magnet **82** is placed in cavity **80**. Similar to cavities **40** and **42**, cavity **80** may be formed using techniques such as, for example, casting, machining, and the like. Preferably, magnet **82** has a ferrite shield **83** and is capable of being oriented in different directions by application of an external magnetic field. Once the desired orientation has been achieved, magnet **82** is maintained in this orientation. For example, an adhesive can be used to hold the magnet in place. Alternatively, magnet **82** may be placed on a movable fixture (not shown) which is coupled to, for example, a dial on the golf club head. Thus, a golfer can adjust the viscosity of the magneto-rheological fluid by turning the dial. Selecting the desired orientation of the magnet and fixing it in that orientation is referred to as tuning or programming the golf club. Magnet **82** creates a magnetic field that interacts with magneto-rheological fluids **60** and **62** and changes their viscosities. Thus, magnet **82** can be oriented to either increase or decrease the strength of the magnetic field that interacts with magneto-rheological fluids **60** and **62**. In accordance with one embodiment, the viscosities of magneto-rheological fluids **60** and **62** are selected such that they are the same after tuning with magnet **82**. In accordance with another embodiment, magneto-rheological fluid **60** is selected to be of higher viscosity than magneto-rheological fluid **62** after tuning with magnet **82**. In accordance with yet another embodiment, magneto-rheological fluid **62** is selected to be of higher viscosity than magneto-rheological fluid **60** after tuning with magnet **82**. The viscosities of the magneto-rheological fluids are not limitations of the present invention.

In operation, magneto-rheoligical fluids **60** and **62** are tuned to have a desired viscosity by orienting magnet **82** so that the strength of the portion of its magnetic field that interacts with magneto-rheological fluids **60** and **62** causes magneto-rheological fluids **60** and **62** to have the desired viscosity. More particularly, magnet **82** may be oriented to increase or decrease the magnetic field applied to magneto-rheological fluids **60** and **62**, which in turn increases or decreases their viscosities. Thus, the clubface response characteristics of each golf club can be adjusted or tuned to those desired by the individual golfer. For example, golfers may find that adjusting magnet **82** to increase the viscosity of magneto-rheological fluids **60** and **62** improves the distance and accuracy of their shots. In an embodiment in which magnet **82** is coupled to a dial, the golfer can adjust the viscosities by turning the dial. Once the viscosities are tuned, magnet **82** is fixed in place to set the desired clubface response characteristics. Cavities **44** and **46** cooperate with end caps **64** and **68**, O-ring assemblies **66** and **70**, piston assemblies **48** and **54**, and magneto-rheological fluids **60** and **62** to form a shock absorber structure, which allows tuning or adjusting the shock absorber of golf club head **12**.

Thus, golf club head **12** has a body **18** to which golf club face plate **72** having club face **74** is elastically or tunably coupled.

FIGS. **5** and **6** depict views of a golf club in accordance with another embodiment of the present invention. For the sake of clarity, FIGS. **5** and **6** are described contemporaneously with each other rather than sequentially. Briefly, FIG. **5** is a cross-sectional top view of iron-type golf club head **100** in accordance with another embodiment of the present invention. FIG. **6** illustrates an expanded view of the portion of iron-type golf club head **100** encircled by broken line **6** in FIG. **5**. Like iron-type golf club head **12**, iron-type golf club head **100** includes a body and hosel **20** having a cylindrical bore **22** for receiving one end of golf club shaft **14**. Because the cavities formed in the body of club head **100** have a different shape than the cavities formed in the body of club head **12**, the body of club head **12** is identified by reference number **102**. Body **102** includes heel end **24**, toe end **26**, sole **28**, top rail **30**, back surface **32**, and front surface **34**. Club head **100** may be formed by casting, machining from solid castings, or the like. Suitable materials for club head **12** include, but are not limited to, stainless steel, titanium, aluminum, nickel, alloys of titanium, alloys of aluminum, alloys of nickel.

Cavities **104** and **106** are formed in body **102**. Although cavities **104** and **106** are shown as being U-shaped, the shape of cavities **104** and **106** is not a limitation of the present invention. A sealable, collapsible bag **108** containing magneto-rheological fluid **110** is placed in cavity **104** and a sealable, collapsible bag **112** also containing a magneto-rheological fluid **114** is placed on or over sealable bag **108**. Alternatively, bags **108** and **112** may be sealable collapsible balloons. The viscosity of magneto-rheological fluids **110** and **114** may be the same or different depending on the desired amount of dampening it will give to golf club face **74**. A sealable bag **116** containing magneto-rheological fluid **118** is placed in cavity **106** and a sealable bag **120** also containing a magneto-rheological fluid **122** is placed on or over sealable bag **116**. The viscosity of magneto-rheological fluids **118** and **120** may be the same or different depending on the desired amount of dampening. Further, the viscosity of magneto-rheological fluids **110**, **114**, **118**, and **122** may be the same as or different from each other. The number of sealable bags **108**, **112**, **116**, and **120** is not a limitation of the present invention. Thus, a single sealable bag, two sealable bags, or more than two sealable bags may be associated with each cavity **104** and **106**. Preferably, sealable bags **108**, **112**, **116**, and **120** are made from an elastic material that is impermeable to magneto-rheological fluid. It should be understood that the material filling the sealable bags is not limited to a magneto-rheological fluid. Other suitable rheological materials include magneto-rheological gels, electro-rheological fluids, and the like.

Sealable bag **108** is attached to a bottom portion of cavity **104** using an adhesive and sealable bag **112** is attached to sealable bag **108** using an adhesive. Sealable bag **116** is attached to a bottom portion of cavity **106** using an adhesive and sealable bag **120** is attached to sealable bag **116** using an adhesive. Although it is preferable that the adhesives used for attaching or bonding be the same, this is not a limitation of the present invention, i.e., they may be different.

A cavity **105** is formed in body **102** and a magnet **107** is placed in cavity **105**. Like magnet **82**, magnet **107** preferably has a ferrite shield **109** and is capable of being oriented in different directions by application of an external magnetic field. Magnet **107** creates a magnetic field that interacts with magneto-rheological fluids **110**, **114**, **118**, and **122** and changes their viscosities. Thus, magnet **107** can be oriented to either increase or decrease the strength of the portion of the magnetic field that interacts with magneto-rheological fluids **110**, **114**, **118**, and **122**, which in turn increases or decreases their viscosities. In accordance with one embodiment, the viscosities of magneto-rheological fluids **110**, **114**, **118**, and **122** are selected such that they are the same after tuning with magnet **107**. In accordance with another embodiment, magneto-rheological fluids **110** and **114** are selected to be of higher viscosity than magneto-rheological fluids **118** and **122** after tuning with magnet **107**. In accordance with yet another embodiment, magneto-rheological fluids **118** and **122** are selected to be of higher viscosity than magneto-rheological fluids **110** and **114** after tuning with magnet **107**. In accordance with yet another embodiment, magneto-rheological fluids **110** and **118** are selected to be of higher viscosity than magneto-rheological fluids **114** and **122** after tuning with magnet **107**. It should be understood that the combination of viscosities of the magneto-rheological fluids is not a limitation of the present invention. For example, among other combinations, magneto-rheological fluids **114** and **122** are selected to be of higher viscosity than magneto-rheological fluids **110** and **118** after tuning with magnet **107**.

A golf club face plate **72** having a front surface **74** for impacting a golf ball and a back surface **76** is attached to sealable bags **112** and **120**. More particularly, sealable bags **112** and **120** are attached to back surface **76** using an adhesive.

In operation, magneto-rheoligical fluids **110**, **114**, **118**, and **122** are tuned to have a desired viscosity by orienting the direction of the magnetic field emanating from magnet **107**. Magnet **107** may be oriented to increase or decrease the magnetic field applied to magneto-rheological fluids **110**, **114**, **118**, and **122**, which in turn increases or decreases their viscosities. Thus, the clubface response characteristics of each golf club can be adjusted or tuned to those desired by the individual golfer. For example, a golfer may find that adjusting magnet **107** to increase the viscosity of magneto-rheological fluids **110** and **114** and to decrease the viscosity of magneto-rheological fluids **118** and **122** improves the distance and accuracy of that golfer's shots. Once the viscosities are tuned, magnet **107** is fixed in place to set the desired clubface response characteristics.

FIGS. **7** and **8** depict views of a golf club in accordance with yet another embodiment of the present invention. For the sake of clarity, FIGS. **7** and **8** are described contemporaneously with each other rather than sequentially. Briefly, FIG. **7** is a cross-sectional top view of iron-type golf club head **150** in accordance with another embodiment of the present invention. FIG. **8** illustrates an expanded view of the portion of iron-type golf club head **150** encircled by broken line **8** in FIG. **7**. Like iron-type golf club head **100**, iron-type golf club head **150** includes body **102** and hosel **20** having cylindrical bore **22** for receiving one end of golf club shaft **14**. Body **102** includes heel end **24**, toe end **26**, sole **28**, top rail **30**, back surface **32**, and front body surface **34**. Club head **150** is preferably cast from stainless steel. Body **102** also has cavities **104**, **105**, and **106** and a magnet **107** having a ferrite shield **109**. Hosel **20** includes a neck **21** connected to heel end **24** of body **102**. A spring **152** having ends **154** and **156** is attached to the bottom of cavity **104** and a spring **158** having ends **160** and **162** is attached to the bottom of cavity **106**. Preferably, ends **154** and **160** include a coiled portion for attachment to the bottoms of cavities **104** and **106**, respectively, whereas ends **156** and **162** are straight portions for attachment to back surface **76** of face plate **72**.

A magneto-rheological fluid **164** is placed in cavity **104** and magneto-rheological fluid **166** is placed in cavity **106**. Cavity **104** is sealed with an end cap **168** and O-ring assembly **170** and cavity **106** is sealed with an end cap **172** and O-ring assembly **174**. The mechanism for sealing cavities **104** and **106** is not a limitation of the present invention. Other sealing mechanisms that prevent leakage of magneto-rheological fluid from cavities **104** and **106**, prevent air from entering cavities **104** and **106**, and align ends **156** and **162** may be used.

In operation, magneto-rheoligical fluids **164** and **166** are tuned to have a desired viscosity by orienting the direction of the magnetic field from magnet **107**. More particularly, magnet **107** may be oriented to increase or decrease the magnetic field applied to magneto-rheological fluids **164** and **166**, which in turn increases or decreases their viscosities. Changing the viscosities of magneto-rheological fluids **164** and **166** effectively changes the spring constants of springs **152** and **158**, respectively. Thus, the clubface response characteristics of each golf club can be adjusted or tuned to those desired by the individual golfer. For example, a golfer may find that adjusting magnet **107** to increase the viscosity of magneto-rheological fluids **164** and **166** improves the distance and accuracy of their shots. Once the viscosities are tuned, magnet **107** is fixed in place to set the desired clubface response characteristics.

Referring now to FIG. **9**, a cross-sectional top view of iron-type golf club head **200** in accordance with another embodiment of the present invention is illustrated. Like iron-type golf club heads **100** and **150**, iron-type golf club head **200** includes body **102** and hosel **20** having cylindrical bore **22** for receiving one end of golf club shaft **14**. Body **102** includes heel end **24**, toe end **26**, sole **28**, top rail **30**, back surface **32**, and front surface **34**. Hosel **20** includes a neck **21** connected to heel end **24** of body **102**. Club head **200** is preferably cast from stainless steel. Body **102** also has cavities **104** and **106**. A piston assembly **202** is coupled to cavity **104** and a piston assembly **204** is coupled to cavity **106**. Piston assembly **202** comprises a cylindrical vessel **206** containing a piston **208** having a piston rod **210** coupled thereto. Cylindrical vessel **206** also contains a magneto-rheological fluid **212**. Cylindrical vessel **206** is sealed with an end cap **214** and an O-ring assembly **216**. Piston rod **210** extends through O-ring assembly **216** and protrudes from front surface **34**. Optionally, a coupling plate **218** is mounted to the exposed end of piston rod **210**. Coupling plate **218** may be welded or adhesively attached to back surface **76** of golf club face plate **72**. Alternatively and similarly to golf club head **12**, piston rod **210** can be adhesively bonded to golf club face plate **72**, or threaded and screwed into threaded grooves in golf club face plate **72**, or attached using set screws.

Piston assembly **204** comprises a cylindrical vessel **220** containing a piston **222** having a piston rod **224** coupled thereto. Cylindrical vessel **220** also contains a magneto-rheological fluid **226**. Cylindrical vessel **220** is sealed with an end cap **228** and an O-ring assembly **230**. Piston rod **224** extends through O-ring assembly **230** and protrudes from front surface **34**. Optionally, a coupling plate **232** is mounted to the exposed end of piston rod **224**. Coupling plate **232** may be welded or adhesively attached to back surface **76** of golf club face plate **72**. Alternatively and like piston rod **210**, piston rod **224** can be adhesively bonded to golf club face plate **72**, or threaded and screwed into threaded grooves in golf club face plate **72**, or attached using set screws. The mechanism for sealing cylindrical vessels **206** and **220** is not a limitation of the present invention. Other sealing mechanisms that prevent leakage of magneto-rheological fluid from cylindrical assemblies **206** and **220**, prevent air from entering cylindrical assemblies **206** and **220**, and align the exposed ends of piston rods **210** and **224** may be used.

Although cylindrical vessels **206** and **220** are shown as abutting or frictionally fitting within cavities **104** and **106**, this is not a limitation of the present invention. For example, there may be a gap between cavities **104** and **106** and cylindrical vessels **206** and **220**, respectively.

Like golf club heads **100** and **150**, a cavity **105** is formed in body **102** and a magnet **107** is placed in cavity **105**. Magnet **107** creates a magnetic field that interacts with and changes the viscosity of magneto-rheological fluid **212**. Thus, magnet **107** can be oriented to either increase or decrease the strength of the portion of the magnetic field that interacts with magneto-rheological fluid **212**. In accordance with one embodiment, a cavity **240** is formed in body **102** and a magnet **242** having a ferrite shield **244** is placed in cavity **240**. Magnet **242** creates a magnetic field that interacts with and changes the viscosity of magneto-rheological fluid **226**. Thus, magnet **242** can be oriented to either increase or decrease the strength of the portion of the magnetic field that interacts with magneto-rheological fluid **226**. Although two cavities and two magnets are shown for changing the viscosities of the magneto-rheological fluids, it should be understood this is not a limitation of the present invention. For example, a single magnet may be used to change the viscosities of the magneto-rheological fluids.

In operation, magneto-rheoligical fluids **212** and **226** are tuned to have a desired viscosity by orienting the direction of the magnetic field emanating from magnets **107** and **242**, respectively. More particularly, magnet **107** may be oriented to increase or decrease the magnetic field applied to magneto-rheological fluid **212**, which in turn increases or decreases its viscosity. Magnet **242** can be oriented to increase or decrease the magnetic field applied to magneto-rheological fluid **226**, which in turn increases or decreases the viscosity of magneto-rheological fluid **226**. Thus, the clubface response characteristics of each golf club can be adjusted or tuned to those desired by the individual golfer. For example, golfers may find that adjusting magnet **107** to increase the viscosity of magneto-rheological fluid **212** and adjusting magnet **242** to decrease the viscosity of magneto-rheological fluid **226** improves the distance and accuracy of their drives. Once the viscosities are tuned, magnets **107** and **242** are fixed in place to set the desired clubface response characteristics.

By now it should be appreciated that a golf club comprising an golf club head having club face elastically coupled thereto and a method for tuning the golf club have been provided. An advantage of the present invention is that it allows golfers to adjust their clubs for different playing environments, e.g., fast greens, changing from low par to high par golf courses, etc. Another advantage of the present invention is that it allows golfers to adjust their clubs in accordance with the sound made by a golf club when impacting the golf ball. Golfers can use the specific sound quality to determine the quality with which they are striking the golf ball with the golf club. Further, a golf club can be tuned so that it hits a golf ball the same distance independent of where it hits the face of the golf club head, i.e., the golf clubs can be tuned so that golf balls hit by golf clubs at the toe end or heel end of the golf club head travel the same distance as golf balls hit by golf clubs at the center of the face of the golf club head.

Although certain preferred embodiments and methods have been disclosed herein, it will be apparent from the foregoing disclosure to those skilled in the art that variations and modifications of such embodiments and methods may be made without departing from the spirit and scope of the invention. For example, there may be a magnet associated with each shock absorber means, i.e., if there are two structures for absorbing shock, a magnet is associated with each one yield a total of two magnets. It is intended that the invention shall be limited only to the extent required by the appended claims and the rules and principles of applicable law.

What is claimed is:

1. A method for tuning a golf club head, comprising:

providing a body having first and second T-shaped cavities, a front surface, a back surface, a heel end, a toe end, a sole extending between lower portions of the heel and toe ends, a top rail extending between upper portions of the heel and toe ends, and a cavity extending from the top rail into the body, the cavity having a bottom;

coupling a shock absorber structure to the body including providing first and second piston assemblies each with a piston coupled to a piston rod, placing the first piston assembly in the first T-shaped cavity and the second piston assembly in the second T-shaped cavity, placing rheological material in the first and second T-shaped cavities, sealing the first and second T-shaped cavities, coupling the face plate to the piston rod; and

coupling a face plate to the shock absorber structure.

2. The method of claim **1**, wherein the step of placing rheological material in the first and second T-shaped cavities includes selecting the rheological material from a group of rheological fluids including a magneto-rheological fluid, an electro-rheological fluid and a magneto-rheological gel.

3. The method of claim **1**, wherein the step of sealing the first and second T-shaped cavities includes sealing the first T-shaped cavity with a first O-ring assembly and sealing the second T-shaped cavity with a second O-ring assembly.

4. A method for tuning a golf club head, comprising:

providing a body having first and second cavities, a front surface, a back surface, a heel end, a toe end, a sole extending between lower portions of the heel and toe ends, a top rail extending between upper portions of the heel and toe ends, and a cavity extending from the top rail into the body, the cavity having a bottom;

coupling a shock absorber structure to the body; and

coupling a face plate to the shock absorber structure including coupling a first bag containing rheological fluid to the first cavity, coupling a second bag containing rheological fluid to the second cavity, and coupling the face plate to the first and second bags.

5. A method for tuning a golf club head, comprising:

providing a body having first and second cavities, a front surface, a back surface, a heel end, a toe end, a sole extending between lower portions of the heel and toe ends, a top rail extending between upper portions of the heel and toe ends, and a cavity extending from the top rail into the body, the cavity having a bottom;

coupling a shock absorber structure to the body; and

coupling a face plate to the shock absorber structure including coupling a first bag containing rheological fluid to the first cavity, coupling a second bag containing rheological fluid to the first bag, coupling a third bag containing rheological fluid to the second cavity, coupling a fourth bag containing rheological fluid to the third bag, and coupling the face plate to the second and fourth bags.

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